

# Facing up to the Grand Challenges

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Every parliamentary constituency in Britain faces its own unique challenges. And yet the big tests facing society are shared across the nation, and indeed throughout the world. Secure and nutritious food supplies; access to clean water; affordable healthcare; public safety and mitigating the impact of climate change – these challenges affect us all and global solutions are called for if we are to sustain a viable planet with more equitable distribution of wealth and resources.

These issues are often termed ‘grand challenges’. They are global in both scale and scope, daunting in nature and for many people, policymakers included, sit in the ‘horribly difficult’ pile earmarked for tackling by someone else. Seemingly as intractable as the legendary Gordian Knot, it’s entirely understandable that people frequently choose to focus on secondary challenges that are closer to home. However, the world is changing at a frightening pace. Millions of people still lack solutions to these grand challenges and those who do – or at least did – are facing real difficulties, perhaps for the first time in their lives, with rising food prices, fuel costs and the visible impact of climate change beginning to take effect.

## Opportunity or threat?

Grand challenges pose both opportunities and threats to policy makers. Opportunities, societal and economic, for those with the solutions; threats for those who fail to address the challenges and curb public unease. But who are the problem solvers – who will provide the secure food supplies, the clean water, improved healthcare and cleaner energy? Shared challenges dictate shared solutions and

engineers will play a pivotal role.

Last year, the Institution of Chemical Engineers (IChemE) published a *Roadmap for 21st Century Chemical Engineering*<sup>1</sup>. The report which featured in the pages of this journal twelve months ago<sup>2</sup> outlined the chemical engineering approach towards tackling six major challenges facing humanity and contained a series of short, medium and long-term action plans that the Institution and its 27,000 international membership should progress in pursuit of a sustainable future. On launching the Roadmap, IChemE Vice President, Ian Shott, described the contribution chemical engineers could make: “Chemical Engineering is playing an increasing role in meeting society’s needs, from energy generation to food production, water supply to waste management and from consumer goods to healthcare products.”

Already there are many examples of chemical engineering expertise being used to tackle pressing international issues. Chemical engineers at BASF have designed a more environmentally friendly process for the manufacture of nylon. The new technique reduces emissions of harmful oxides of nitrogen by simplifying the production of an intermediate chemical, cyclododecanone, thereby cutting the number of process steps from four to two. Further afield, New Zealander, Howard Bradbury, has developed a novel drying technique to remove potentially fatal levels of cyanide from cassava flour, a staple food in the diet of many poorer communities. Quite literally, an example of how chemical engineers can save lives. Both of these projects were recognised at the Institution’s Annual Innovation and Excellence Awards in London last autumn.



## A profession in demand

Unsurprisingly chemical engineers are in demand, at home and abroad. It’s a career path that’s proving increasingly appealing to students in the UK too. Last year, UK universities saw a record number of students opting to study chemical engineering, with an all-time high figure of 1455 undergraduate students starting first degree courses. Since 2001, applications to study chemical engineering in the UK have grown by more than 70% and admissions have risen by 55% as a result.

The Head of Chemical Engineering at Glasgow’s Strathclyde University, Dr Carl Schaschke said: “The upturn in interest in chemical engineering nationally is a reflection of the changing role and unique skills of the chemical engineer. Now, more than at any time in the past, chemical engineers can be found central to meeting the societal needs of energy provision, health care and tackling head-on crucial environmental issues that affect everyone.”

Securing a healthy pipeline of high-quality chemical engineers is good news for industry and society. It’s good news for graduates too. New figures reveal that 2007 graduate starting salaries averaged £26,000 and packages exceeding £30,000 were not unusual.

## Image problem

Despite this, chemical engineering – and engineering as a whole – still

needs to work on its image. A recent Engineering and Technology Board study<sup>3</sup> looking at public perceptions of engineering and engineers revealed that awareness and understanding of engineers and engineering tended to be narrowly defined and primarily related to construction and manual professions. The quantitative survey findings showed that the word 'engineer' most commonly triggered images of construction and mechanics – associating engineers primarily with building and fixing things than rather than design, innovation and creativity.

In 2007, to coincide with the 50th Anniversary of its Royal Charter, IChemE asked Ipsos MORI to research public perceptions of chemical engineering. The survey, which assessed the views of 2000 people, provided a sobering view of public attitudes and understanding of our profession. Over a third of people surveyed had no idea what 'chemical engineering' meant. A further quarter admitted to only a vague idea.

ABCIs claimed a better understanding of chemical engineering with just over half of the respondents in this category agreeing with the proposition that chemical engineers were important to the UK economy. This trend was reinforced amongst older respondents and those educated to degree level.

55% of those surveyed believed that chemical engineers 'use advanced technology', whilst 38% agreed that chemical engineering 'improves the quality of the products we buy'. Amongst other findings, 29% believed that chemical engineering was 'increasing in importance' and 31% thought that chemical engineering 'offered a career with good prospects'. Conversely, two out of three people disagreed with these propositions. This presents quite a headache for a profession that is working hard to improve its reputation and secure public confidence through engagement and influence programmes particularly with young people via its well regarded *whynotchemeng* careers campaign.

## The benefits of innovation

And yet there are many examples of chemical engineers here in the UK who are making real progress on the

grand challenges described at the beginning of this article. Arnold Black, a chemical engineering graduate of Leeds University, manages a team of twenty (many of them chemical engineers) in his role as Network Director at the Resource Efficiency Knowledge Transfer Network. His team provides services to industry and academe, promoting innovation and commercial environmental solutions in the field of resource efficiency.

Black's broad remit covers everything from resource-efficient manufacturing in food processing and consumer goods manufacture through to recovery of materials from waste streams such as electronic scrap and construction material. This can include technologies such as bio-technologies for alternative fuels and electrochemical water clean-up.

In Cambridge, chemical engineers working for Stem Cell Sciences UK, are pioneering bio-manufacturing processes for the automated production and manipulation of stem cells. Stem cells are a potential source of research, screening of new drugs and cell therapy but the challenge is generating enough high-quality stem cells to allow sufficient research.

And in Cardiff, chemical engineers have designed an innovative way of producing catalysts, using acetates and carbon dioxide rather than nitrates to significantly reduce their environmental harm, eliminating energy-intensive precipitation, solvent and waste.

## Skill shortages loom

Such innovation will benefit both the environment and the UK economy but it's only possible with a secure pipeline of chemical engineers. However, alongside the looming problems of climate change there is another issue that requires urgent attention – a shortage of scientists and engineers to maintain and build on existing work as older professionals retire.

The UK process sector is now paying the price for the dramatic downturn in the number of students studying chemical engineering in the mid-1990s. Engineering recruitment agencies are already searching as far afield as Brazil and Nigeria to fill

vacancies. And in the future, as the demand for skilled chemical engineers grows internationally, this could become a major problem presenting both government and business with severe difficulties for example, in the battle to cut carbon emissions through the deployment of clean coal technology, carbon capture, nuclear power generation and renewables.

## Facing up to the grand challenges

There has probably never been a better time to be a chemical engineering student. Employers continually lament a tight recruitment market, the sit vac pages of process sector publications are expanding and graduate salaries are on the up. The grand challenges, it would seem, are fuelling the demand for chemical engineers?

Nonetheless, we must not rest on our laurels. In 2007 many UK chemical engineering degree courses are either at, or are fast approaching, capacity. Whilst this is having a beneficial effect on the quality of the undergraduate intake, a shortage of places does not bode well for a future in which the grand challenges will become even more exacting. Government, industry and professional bodies, including IChemE, must work together to meet the demand for extra places.

In the years ahead, governments in all nations will be under pressure to demonstrate that they are facing up to the grand challenges with policies and strategies that will secure a sustainable society.

Delivering those policies and strategies will require skilled scientists and technologists to make things happen. Here in the UK policy makers can safeguard the future by securing a healthy supply of chemical and process engineers – 21st Century problem solvers capable of solving knotty problems with bold strokes.

<sup>1</sup> <http://www.icheme.org/roadmap2007.pdf>

<sup>2</sup> Shared Challenges, Shared Solutions, Dr. Ramesh Mashelkar, Science in Parliament, Summer 2007 pp12-13

<sup>3</sup> Public Attitudes to and Perceptions of Engineering and Engineers 2007, Engineering and Technology Board